

RoHS

# Operational Amplifier Series

# Automotive Low Noise Operational Amplifiers



# General Description

BA4560Yxxx-M integrates two independent Op-Amps on a single chip. This Op-Amp has some features of low noise and low distortion characteristics and can operate from ±4.0V to ±15V(split supply). BA4560Yxxx-M is manufactured for automotive requirements of car navigation system, car audio, etc.

#### Features

- AEC-Q100 Qualified
- High voltage gain
- Iow noise
- Iow distortion
- Wide operating supply voltage
- Internal ESD protection circuit
- Wide operating temperature Range

#### Application

- Car Navigation System
- Car Audio

#### Simplified schematic

# •Key Specifications

- Wide operating supply voltage
- (split supply):±4.0V to ±15VWide Temperature Range:-40°C to +105°CHigh Slew Rate: $1V/\mu s(Typ.)$ Total Harmonic Distortion :0.003%(Typ.)Input Referred Noise Voltage : $8 nV/\sqrt{Hz}$  (Typ.)

#### Packages

SOP8 SSOP-B8 MSOP8 W(Typ.) xD(Typ.) xH(Max.) 5.00mm x 6.20mm x 1.71mm 3.00mm x 6.40mm x 1.35mm 2.90mm x 4.00mm x 0.90mm

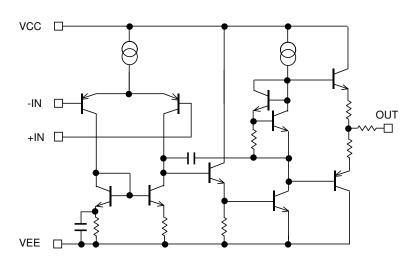
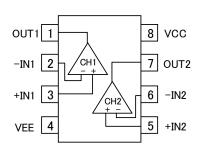


Figure 1. Simplified schematic (one channel only)

OProduct structure : Silicon monolithic integrated circuit OThis product is not designed protection against radioactive rays.

# Pin Configuration

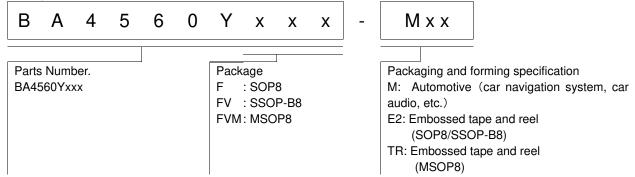
BA4560YF-M : SOP8 BA4560YFV-M : SSOP-B8 BA4560YFVM-M : MSOP8



Pin No.	Symbol
1	OUT1
2	-IN1
3	+IN1
4	VEE
5	+IN2
6	-IN2
7	OUT2
8	VCC

Package						
SOP8	SSOP-B8	MSOP8				
BA4560YF-M	BA4560YFV-M	BA4560YFVM-M				

# Ordering Information



#### ●Line-up

Topr	Supply voltage	Number of channels	Pack	Package Orderable Parts Num		
			SOP8	Reel of 2500	BA4560YF-ME2	
-40°C to +105°C	-40°C to +105°C ±4.0V to ±15V	Dual	SSOP-B8	Reel of 2500	BA4560YFV-ME2	
			MSOP8	Reel of 3000	BA4560YFVM-MTR	

# ● Absolute Maximum Ratings(Ta=25°C)

Parameter	Symbol VCC-VEE		Ratings	Unit
Supply Voltage			+36	V
		SOP8	775 <sup>*1*4</sup>	
Power Dissipation	Pd	SSOP-B8	625 <sup>*2*4</sup>	mW
		MSOP8	600 <sup>*3*4</sup>	
Differential Input Voltage *5		Vid +36		V
Input Common-mode Voltage Range		Vicm	(VEE-0.3) to (VEE+36)	V
Operating Supply Voltage		Vopr	+8.0 to +30 (±4.0 to ±15)	V
Operating Temperature Range	Topr		-40 to +105	°C
Storage Temperature Range	Tstg		-55 to +150	°C
Maximum Junction Temperature	Tjmax		+150	°C

Note: Absolute maximum rating item indicates the condition which must not be exceeded.

Application if voltage in excess of absolute maximum rating or use out of absolute maximum rated temperature environment may cause deterioration of characteristics.

\*1 To use at temperature above  $Ta=25^{\circ}C$  reduce 6.2mW/°C.

\*2 To use at temperature above Ta=25°C reduce 5.0mW/°C.

\*3 To use at temperature above Ta=25°C reduce 4.8mW/°C.

\*4 Mounted on a FR4 glass epoxy PCB(70mm×70mm×1.6mm).

\*5 The voltage difference between inverting input and non-inverting input is the differential input voltage. Then input terminal voltage is set to more than VEE.

# •Electrical Characteristics

OBA4560Yxxx-M (Unless otherwise specified VCC=+15V, VEE=-15V, Full range -40°C to +105°C)

ODA4500 FXX-IM (OTHESS OTHERWISE	opeeniea	, 000-1101,		<b>o v</b> , i un i	ango i	00.0	1100 0)	
Parameter	Symbol	Temperature		Limits		Unit	Condition	
raidmeter	Symbol	Range	Min.	Тур.	Max.	Onit	Condition	
Input Offset Voltage *6	Vio	25°C	-	0.5	6	mV	OUT=0V	
input Onset voltage	VIO	Full range	-	-	7	111 V	001=00	
Input Offset Current <sup>*6</sup>	lio	25°C	-	5	200	nA	OUT=0V	
input Onset Gunent		Full range	-	-	200		001=00	
Input Bias Current *7	lb	25°C	-	50	500	nA	OUT=0V	
input bias ourient	ŭ	Full range	-	-	800		001=00	
Supply Current	ICC	25°C	-	3	7	mA	RL=∞, All Op-Amps	
Supply Current	100	Full range	-	-	7.5		VIN+=0V	
Maximum Output Voltage	VOM	25°C	±12	±14	-	v	RL≧2kΩ	
Maximum Output Voltage	VOIVI	Full range	±10	±11.5	-	v	lo=25mA	
Large Signal Voltage Gain	Av	25°C	86	100	-	dB	RL≧2kΩ, VO=±10V	
Large Signal Voltage Gain	AV	Full range	83	-	-	uр	Vicm=0V	
Input Common-mode Voltage Range	Vicm	25°C	±12	±14	-	v	OUT=±12V	
input common-mode voltage mange		Full range	±12	-	-	v	001-1121	
Common-mode Rejection Ratio	CMRR	25°C	70	90	-	dB	OUT=±12V	
Power Supply Rejection Ratio	PSRR	25°C	76.5	90	-	dB	Ri≦10kΩ	
Slew Rate	SR	25°C	-	4	-	V/µs	Av=0dB, RL=10kΩ CL=100pF	
Unity Gain Frequency	f⊤	25°C	-	4	-	MHz	RL=2kΩ	
Total Harmonic Distortion +Noise	THD+N	25°C	-	0.003	-	%	Av=20dB, RL=10kΩ VIN=0.05Vrms, f=1kHz	
Input Referred Noise Voltage	Ve	25°C	-	8	-	nV/√Hz	RS=100Ω, Vi=0V, f=1kHz	
Input Referred Noise Voltage	Vn	230	-	1.0	-	µVrms	DIN-AUDIO	
Channel Separation	CS	25°C	-	105	-	dB	R1=100Ω, f=1kHz	

\*6 Absolute value\*7 Current direction

7 Current direction: Since first input stage is composed with PNP transistor, input bias current flows out of IC.

## **Description of electrical characteristics**

Described here are the terms of electric characteristics used in this datasheet. Items and symbols used are also shown. Note that item name and symbol and their meaning may differ from those on another manufacture's document or general document.

#### 1. Absolute maximum ratings

Absolute maximum rating item indicates the condition which must not be exceeded. Application of voltage in excess of absolute maximum rating or use out of absolute maximum rated temperature environment may cause deterioration of characteristics.

1.1 Power supply voltage (VCC-VEE)

Indicates the maximum voltage that can be applied between the positive power supply terminal and negative power supply terminal without deterioration or destruction of characteristics of internal circuit.

- 1.2 Differential input voltage (Vid) Indicates the maximum voltage that can be applied between non-inverting terminal and inverting terminal without deterioration and destruction of characteristics of IC.
- 1.3 Input common-mode voltage range (Vicm)

Indicates the maximum voltage that can be applied to non-inverting terminal and inverting terminal without deterioration or destruction of characteristics. Input common-mode voltage range of the maximum ratings not assure normal operation of IC. When normal operation of IC is desired, the input common-mode voltage of characteristics item must be followed.

1.4 Power dissipation (Pd)

Indicates the power that can be consumed by specified mounted board at the ambient temperature 25°C(normal temperature). As for package product, Pd is determined by the temperature that can be permitted by IC chip in the package (maximum junction temperature) and thermal resistance of the package.

### 2. Electrical characteristics item

2.1 Input offset voltage (Vio)

Indicates the voltage difference between non-inverting terminal and inverting terminal. It can be translated into the input voltage difference required for setting the output voltage at 0V.

2.2 Input offset current (lio)

Indicates the difference of input bias current between non-inverting terminal and inverting terminal.

- 2.3 Input bias current (lb) Indicates the current that flows into or out of the input terminal. It is defined by the average of input bias current at non-inverting terminal and input bias current at inverting terminal.
- 2.4 Circuit current (ICC) Indicates the IC current that flows under specified conditions and no-load steady status.
- 2.5 Output saturation voltage (VOM)
  - Signifies the voltage range that can be output under specific output conditions.
- 2.6 Large signal voltage gain (Av) Indicates the amplifying rate (gain) of output voltage against the voltage difference between non-inverting terminal and Inverting terminal. It is normally the amplifying rate (gain) with reference to DC voltage. Av = (Output voltage) / (Differential Input voltage)
- 2.7 Input common-mode voltage range (Vicm) Indicates the input voltage range where IC operates normally.
- 2.8 Common-mode rejection ratio (CMRR) Indicates the ratio of fluctuation of input offset voltage when in-phase input voltage is changed. It is normally the fluctuation of DC.

CMRR = (Change of Input common-mode voltage)/(Input offset fluctuation)

- 2.9 Power supply rejection ratio (PSRR) Indicates the ratio of fluctuation of input offset voltage when supply voltage is changed. It is normally the fluctuation of DC.
  - PSRR = (Change of power supply voltage) / (Input offset fluctuation)

# 2.10 Slew Rate (SR)

SR is a parameter that shows movement speed of operational amplifier. It indicates rate of variable output voltage as unit time.

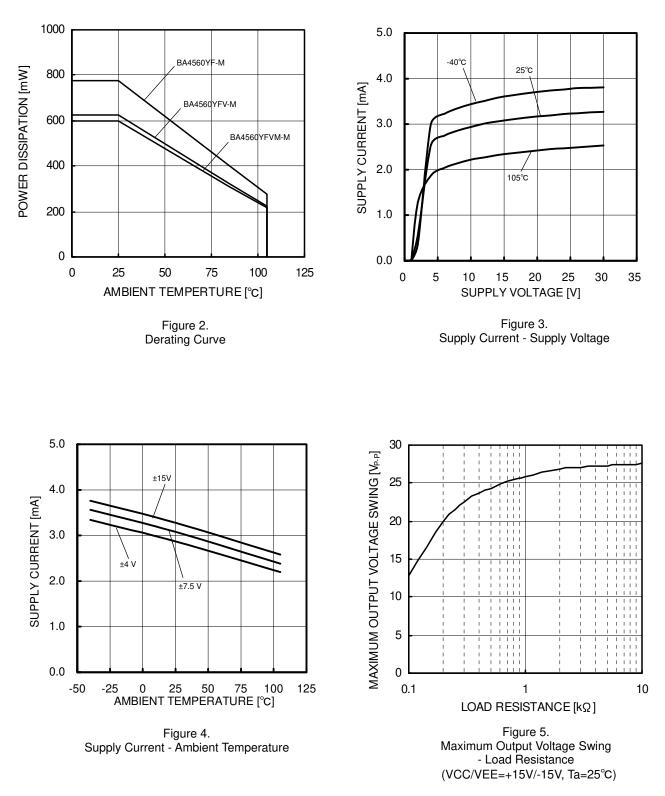
2.11 Unity gain frequency (f<sub>T</sub>)

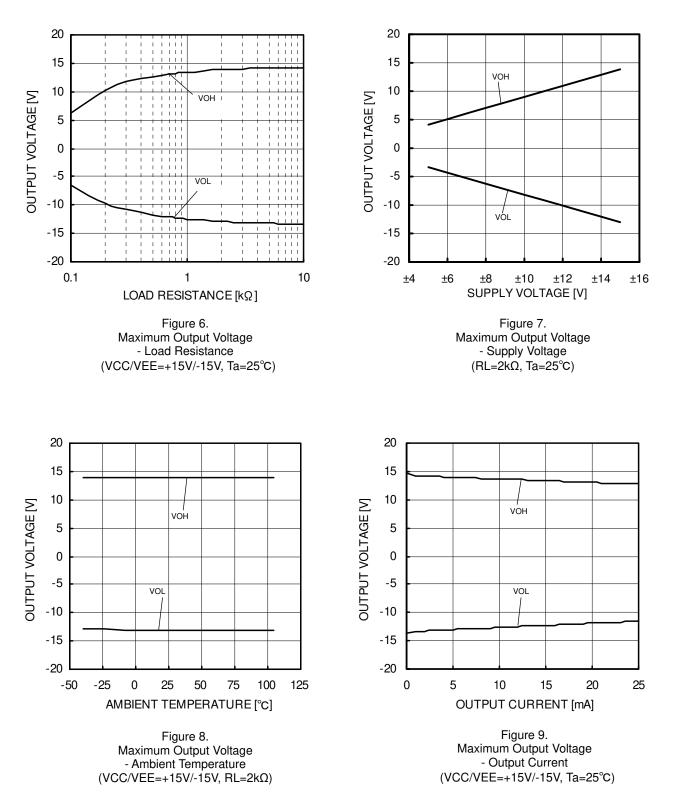
Indicates a frequency where the voltage gain of operational amplifier is 1.

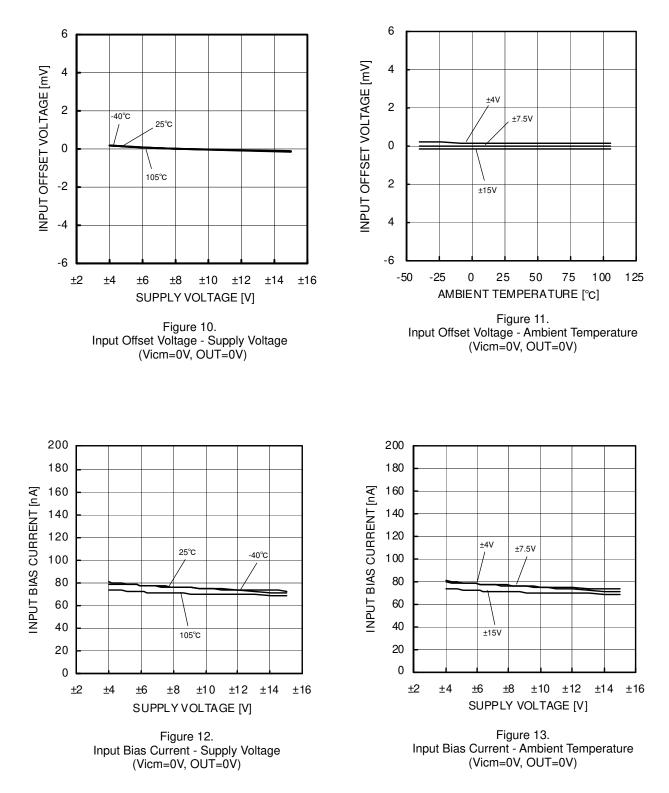
- 2.12 Total harmonic distortion + Noise (THD+N) Indicates the fluctuation of input offset voltage or that of output voltage with reference to the change of output voltage of driven channel.
- 2.13 Input referred noise voltage (Vn) Indicates a noise voltage generated inside the operational amplifier equivalent by ideal voltage source connected in series with input terminal.
- 2.14 Channel separation (CS) Indicates the fluctuation of input offset voltage or that of output voltage with reference to the change of output voltage of driven channel.

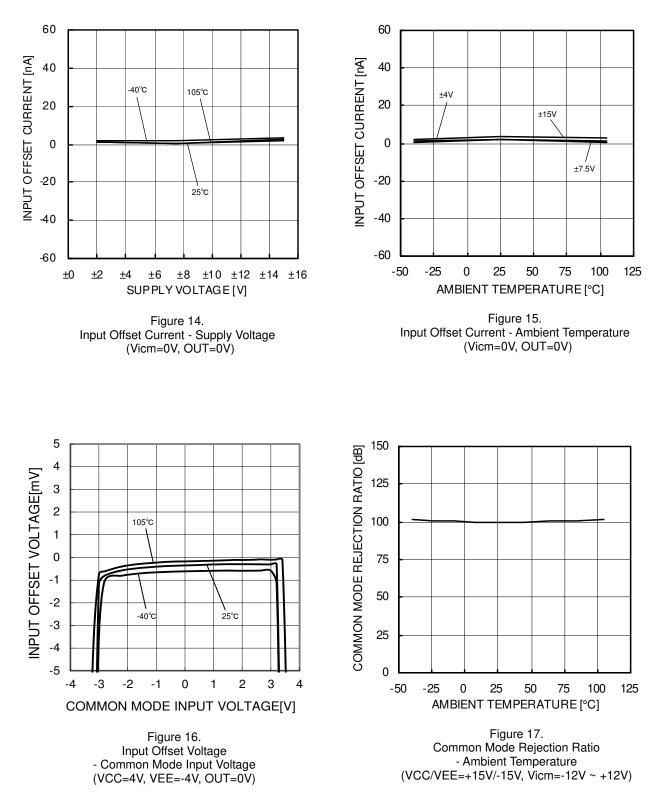
## Typical Performance Curves

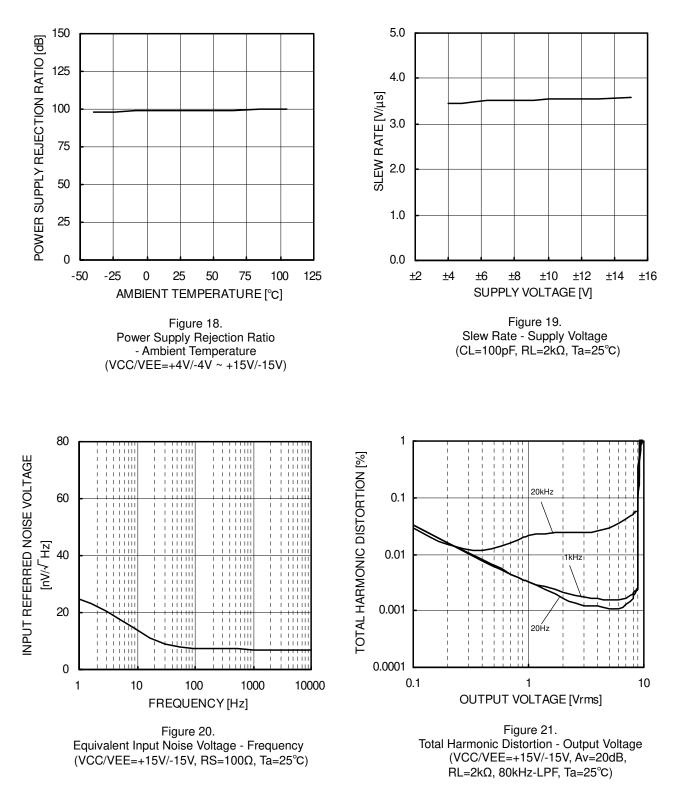
O BA4560Yxxx-M

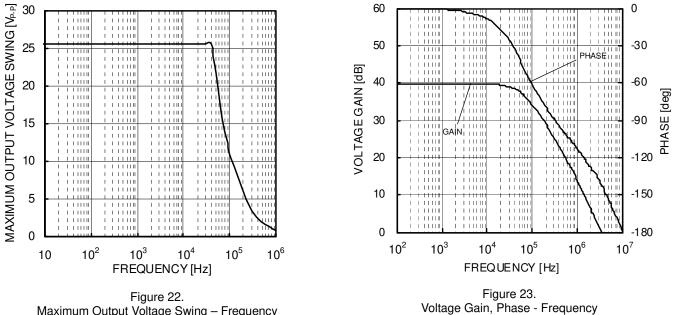












Maximum Output Voltage Swing – Frequency (VCC/VEE=+15V/-15V, RL=2kΩ, Ta=25°C)

(\*) The above data is measurement value of typical sample, it is not guaranteed.

(VCC/VEE=+15V/-15V, Av=40dB,

RL=2kΩ, Ta=25°C)

#### Power Dissipation

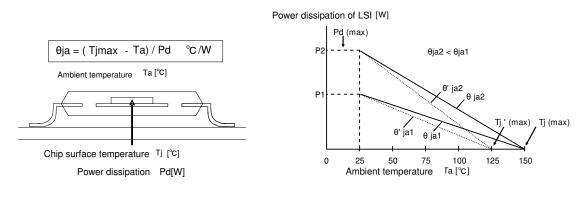
Power dissipation (total loss) indicates the power that the IC can consume at Ta=25°C (normal temperature). As the IC consumes power, it heats up, causing its temperature to be higher than the ambient temperature. The allowable temperature that the IC can accept is limited. This depends on the circuit configuration, manufacturing process, and consumable power.

Power dissipation is determined by the allowable temperature within the IC (maximum junction temperature) and the thermal resistance of the package used (heat dissipation capability). Maximum junction temperature is typically equal to the maximum storage temperature. The heat generated through the consumption of power by the IC radiates from the mold resin or lead frame of the package. Thermal resistance, represented by the symbol  $\theta ja^{\circ}C/W$ , indicates this heat dissipation capability. Similarly, the temperature of an IC inside its package can be estimated by thermal resistance.

Figure 24. (a) shows the model of the thermal resistance of the package. The equation below shows how to compute for the Thermal resistance ( $\theta$ ja), given the ambient temperature (Ta), maximum junction temperature (Tjmax), and power dissipation (Pd).

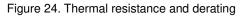
 $\theta_{ja} = (T_{jmax} - T_{a}) / Pd$  °C/W · · · · · (I)

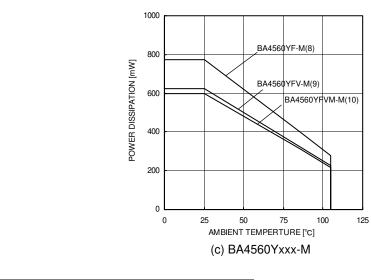
The Derating curve in Figure 24. (b) indicates the power that the IC can consume with reference to ambient temperature. Power consumption of the IC begins to attenuate at certain temperatures. This gradient is determined by Thermal resistance ( $\theta$ ja), which depends on the chip size, power consumption, package, ambient temperature, package condition, wind velocity, etc. This may also vary even when the same of package is used. Thermal reduction curve indicates a reference value measured at a specified condition. Figure 25. (c) shows an example of the derating curve for BA4560Yxxx-M.



(a) Thermal resistance

(b) Derating curve





(8)	(9)	(10)	Unit
6.2	5.0	4.8	mW/°C

When using the unit above Ta=25°C, subtract the value above per Celsius degree . Mounted on a FR4 glass epoxy board 70mm×1.6mm(cooper foil area below 3%)

Figure 25. Derating curve

# Application Information

NULL method condition for Test circuit1

	1						VCC, V	/EE, EK	, Vicm Unit: V
Parameter	VF	S1	S2	S3	VCC	VEE	EK	Vicm	calculation
Input Offset Voltage	VF1	ON	ON	OFF	15	-15	0	0	1
Input Offset Current	VF2	OFF	OFF	OFF	15	-15	0	0	2
Input Bigg Current	VF3	OFF	ON	OFF	15	-15	0	0	3
Input Bias Current	VF4	ON	OFF			-15			3
Large Signal Valtage Cain	VF5	01		ON	15	-15	0	0	4
Large Signal Voltage Gain	VF6	ON	ON		15	-15	0	0	4
Common-mode Rejection Ratio	VF7				3	-27	0	0	5
(Input common-mode Voltage Range)	VF8	ON	ON	OFF	27	-3	0	0	5
Power Supply	VF9		01		4	-4	0	0	G
Rejection Ratio	VF10	ON	ON	OFF	15	-15	0	0	6

- Calculation -

1. Input Offset Voltage (Vio)

$$Vio = \frac{|VF1|}{1 + RF/RS} [V]$$

2. Input Offset Current (lio)

$$lio = \frac{|VF2 - VF1|}{Ri \times (1 + RF / RS)}$$
 [A]

$$lb = \frac{|VF4 - VF3|}{2 \times Ri \times (1 + RF/RS)} [A]$$

4. Large Signal Voltage Gain (Av)

$$Av = 20 \times Log \frac{\Delta EK \times (1 + RF/RS)}{|VF5 - VF6|} \quad [dB]$$

5. Common-mode Rejection Ration (CMRR)

$$CMRR = 20 \times Log \frac{\Delta Vicm \times (1 + RF/RS)}{|VF8 - VF7|} [dB]$$

6. Power supply rejection ratio (PSRR)

$$PSRR = 20 \times Log \frac{\Delta Vcc \times (1 + RF/RS)}{|VF10 - VF9|} [dB]$$

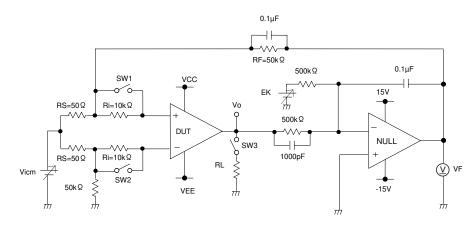


Figure 26. Test circuit1 (one channel only)

# Switch Condition for Test Circuit 2

SW No.	SW 1	SW 2	SW 3	SW 4	SW 5	SW 6	SW 7	SW 8	SW 9	SW 10	SW 11	SW 12	SW 13	SW 14
Supply Current	OFF	OFF	OFF	ON	OFF	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Maximum Output Voltage (high)	OFF	OFF	ON	OFF	OFF	ON	OFF	OFF	ON	OFF	OFF	OFF	ON	OFF
Maximum Output Voltage (Low)	OFF	OFF	ON	OFF	OFF	ON	OFF	OFF	OFF	OFF	OFF	OFF	ON	OFF
Slew Rate	OFF	OFF	OFF	ON	OFF	OFF	OFF	ON	ON	ON	OFF	OFF	OFF	OFF
Unity Gain Frequency	OFF	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON	ON	OFF	OFF	OFF
Total Harmonic Distortion	ON	OFF	OFF	OFF	ON	OFF	ON	OFF	ON	ON	ON	OFF	OFF	OFF
Input Referred Noise Voltage	ON	OFF	OFF	OFF	ON	ON	OFF	OFF	OFF	OFF	ON	OFF	OFF	OFF

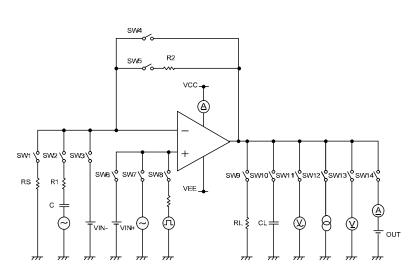
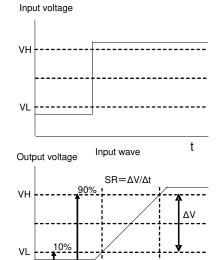


Figure 27. Test Circuit 2 (each Op-Amp)



Output wave Figure 28. Slew Rate Input Waveform

Δt

t

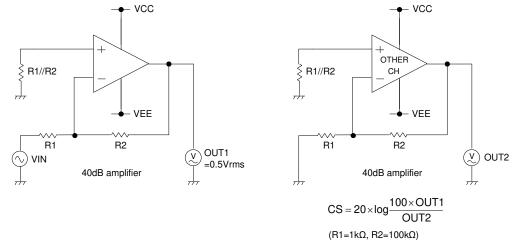


Figure 29. Test Circuit 3(Channel Separation)

# Operational Notes

1) Processing of unused circuit

It is recommended to apply connection (see the Figure 30.) and set the non inverting input terminal at the potential within input common-mode voltage range (Vicm), for any unused circuit.

- 2) Input voltage
- Applying (VEE 0.3) to (VEE + 36)V

(BA4558R) to the input terminal is possible without causing deterioration of the electrical characteristics or destruction, irrespective of the supply voltage. However, this does not ensure normal circuit operation. Please note that the circuit operates normally only when the input voltage is within the common mode input voltage range of the electric characteristics.

3) Maximum output voltage

Because the output voltage range becomes narrow as the output current Increases, design the application with margin by considering changes in electrical characteristics and temperature characteristics.

4) Short-circuit of output terminal

When output terminal and VCC or VEE terminal are shorted, excessive Output current may flow under some conditions, and heating may destroy IC. It is necessary to connect a resistor as shown in Figure 31., thereby protecting against load shorting.

- 5) Power supply (split supply / single supply) in used Op-amp operates when specified voltage is applied between VCC and VEE. Therefore, the single supply Op-Amp can be used for double supply Op-Amp as well.
- 6) Power dissipation (Pd)

Use a thermal design that allows for a sufficient margin in light of the power dissipation (Pd) in actual operating conditions.

- Short-circuit between pins and wrong mounting Pay attention to the assembly direction of the ICs. Wrong mounting direction or shorts between terminals, GND, or other components on the circuits, can damage the IC.
- Use in strong electromagnetic field Using the ICs in strong electromagnetic field can cause operation malfunction.
- 9) Radiation This IC is not designed to be radiation-resistant.
- 10) IC Handling

When stress is applied to IC because of deflection or bend of board, the characteristics may fluctuate due to piezo resistance effects.

11) Inspection on set board

During testing, turn on or off the power before mounting or dismounting the board from the test Jig. Do not power up the board without waiting for the output capacitors to discharge. The capacitors in the low output impedance terminal can stress the device. Pay attention to the electro static voltages during IC handling, transportation, and storage.

12) Output capacitor

When VCC terminal is shorted to VEE (GND) potential and an electric charge has accumulated on the external capacitor, connected to output terminal, accumulated charge may be discharged VCC terminal via the parasitic element within the circuit or terminal protection element. The element in the circuit may be damaged (thermal destruction). When using this IC for an application circuit where there is oscillation, output capacitor load does not occur, as when using this IC as a voltage comparator. Set the capacitor connected to output terminal below  $0.1 \mu$ F in order to prevent damage to IC.

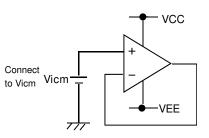


Figure 30. The example of application circuit for unused op-amp

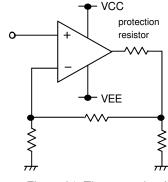
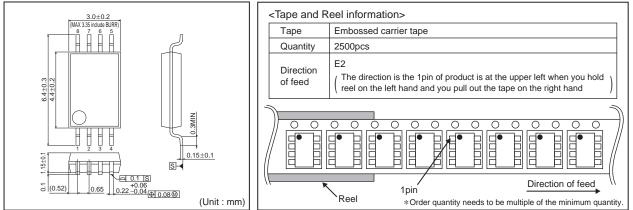


Figure 31. The example of output short protection

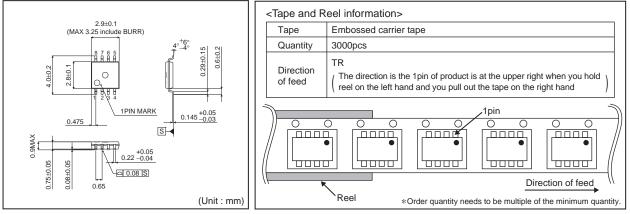
# Physical Dimensions Tape and Reel Information

#### SOP8 <Tape and Reel information> 5.0±0.2 (MAX 5.35 include BURR) Embossed carrier tape Таре Quantity 2500pcs E2 4.4±0.2 0.9±0.15 2±0.3 Direction The direction is the 1pin of product is at the upper left when you hold of feed reel on the left hand and you pull out the tape on the right hand 0.595 0.17 +0.1 С 1.5±0.1 S 0.1 S 0.11 Direction of feed 0.42±0.1 1pin Reel (Unit : mm) \*Order quantity needs to be multiple of the minimum quantity

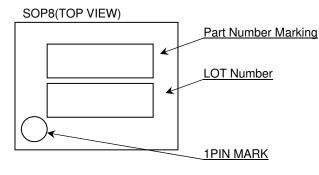
# SSOP-B8

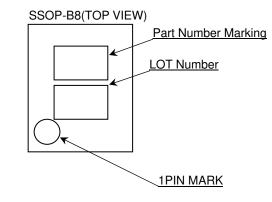


# MSOP8

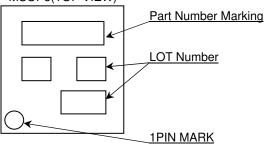


# Marking Diagram





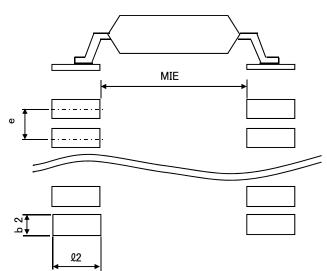
# MSOP8(TOP VIEW)



Product Name		Package Type	Marking		
	F-M	SOP8	60YM		
BA4560Y	FV-M	SSOP-B8	60YM		
	FVM-M	MSOP8	60YM		

# Land pattern data

SOP8, SSOP-B8, MSOP8



			All d	imensions in mm
PKG	Land pitch e	Land space MIE	Land length ≧ℓ2	Land width b2
SOP8	1.27	4.60	1.10	0.76
SSOP-B8	0.65	4.60	1.20	0.35
MSOP8	0.65	2.62	0.99	0.35

# Revision History

Date	Revision	Changes
1.Mar.2013	001	New Release

# Notice

#### Precaution on using ROHM Products

1. If you intend to use our Products in devices requiring extremely high reliability (such as medical equipment <sup>(Note 1)</sup>, aircraft/spacecraft, nuclear power controllers, etc.) and whose malfunction or failure may cause loss of human life, bodily injury or serious damage to property ("Specific Applications"), please consult with the ROHM sales representative in advance. Unless otherwise agreed in writing by ROHM in advance, ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties arising from the use of any ROHM's Products for Specific Applications.

(Note1) Medical Equipment Classification of the Specific Applic	ations
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JAPAN	USA	EU	CHINA
CLASSI	CLASSI	CLASS II b	CLASSⅢ
CLASSⅣ		CLASSⅢ	

2. ROHM designs and manufactures its Products subject to strict quality control system. However, semiconductor products can fail or malfunction at a certain rate. Please be sure to implement, at your own responsibilities, adequate safety measures including but not limited to fail-safe design against the physical injury, damage to any property, which a failure or malfunction of our Products may cause. The following are examples of safety measures:

[a] Installation of protection circuits or other protective devices to improve system safety

[b] Installation of redundant circuits to reduce the impact of single or multiple circuit failure

- 3. Our Products are not designed under any special or extraordinary environments or conditions, as exemplified below. Accordingly, ROHM shall not be in any way responsible or liable for any damages, expenses or losses arising from the use of any ROHM's Products under any special or extraordinary environments or conditions. If you intend to use our Products under any special or extraordinary environments or conditions (as exemplified below), your independent verification and confirmation of product performance, reliability, etc, prior to use, must be necessary:
  - [a] Use of our Products in any types of liquid, including water, oils, chemicals, and organic solvents
  - [b] Use of our Products outdoors or in places where the Products are exposed to direct sunlight or dust
  - [c] Use of our Products in places where the Products are exposed to sea wind or corrosive gases, including Cl<sub>2</sub>, H<sub>2</sub>S, NH<sub>3</sub>, SO<sub>2</sub>, and NO<sub>2</sub>
  - [d] Use of our Products in places where the Products are exposed to static electricity or electromagnetic waves
  - [e] Use of our Products in proximity to heat-producing components, plastic cords, or other flammable items
  - [f] Sealing or coating our Products with resin or other coating materials
  - [g] Use of our Products without cleaning residue of flux (even if you use no-clean type fluxes, cleaning residue of flux is recommended); or Washing our Products by using water or water-soluble cleaning agents for cleaning residue after soldering
  - [h] Use of the Products in places subject to dew condensation
- 4. The Products are not subject to radiation-proof design.
- 5. Please verify and confirm characteristics of the final or mounted products in using the Products.
- 6. In particular, if a transient load (a large amount of load applied in a short period of time, such as pulse. is applied, confirmation of performance characteristics after on-board mounting is strongly recommended. Avoid applying power exceeding normal rated power; exceeding the power rating under steady-state loading condition may negatively affect product performance and reliability.
- 7. De-rate Power Dissipation (Pd) depending on Ambient temperature (Ta). When used in sealed area, confirm the actual ambient temperature.
- 8. Confirm that operation temperature is within the specified range described in the product specification.
- 9. ROHM shall not be in any way responsible or liable for failure induced under deviant condition from what is defined in this document.

#### Precaution for Mounting / Circuit board design

- 1. When a highly active halogenous (chlorine, bromine, etc.) flux is used, the residue of flux may negatively affect product performance and reliability.
- 2. In principle, the reflow soldering method must be used; if flow soldering method is preferred, please consult with the ROHM representative in advance.

For details, please refer to ROHM Mounting specification

#### **Precautions Regarding Application Examples and External Circuits**

- 1. If change is made to the constant of an external circuit, please allow a sufficient margin considering variations of the characteristics of the Products and external components, including transient characteristics, as well as static characteristics.
- 2. You agree that application notes, reference designs, and associated data and information contained in this document are presented only as guidance for Products use. Therefore, in case you use such information, you are solely responsible for it and you must exercise your own independent verification and judgment in the use of such information contained in this document. ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties arising from the use of such information.

#### **Precaution for Electrostatic**

This Product is electrostatic sensitive product, which may be damaged due to electrostatic discharge. Please take proper caution in your manufacturing process and storage so that voltage exceeding the Products maximum rating will not be applied to Products. Please take special care under dry condition (e.g. Grounding of human body / equipment / solder iron, isolation from charged objects, setting of lonizer, friction prevention and temperature / humidity control).

#### **Precaution for Storage / Transportation**

- 1. Product performance and soldered connections may deteriorate if the Products are stored in the places where:
  - [a] the Products are exposed to sea winds or corrosive gases, including Cl2, H2S, NH3, SO2, and NO2
  - [b] the temperature or humidity exceeds those recommended by ROHM
  - [c] the Products are exposed to direct sunshine or condensation
  - [d] the Products are exposed to high Electrostatic
- 2. Even under ROHM recommended storage condition, solderability of products out of recommended storage time period may be degraded. It is strongly recommended to confirm solderability before using Products of which storage time is exceeding the recommended storage time period.
- 3. Store / transport cartons in the correct direction, which is indicated on a carton with a symbol. Otherwise bent leads may occur due to excessive stress applied when dropping of a carton.
- 4. Use Products within the specified time after opening a humidity barrier bag. Baking is required before using Products of which storage time is exceeding the recommended storage time period.

#### **Precaution for Product Label**

QR code printed on ROHM Products label is for ROHM's internal use only.

#### Precaution for Disposition

When disposing Products please dispose them properly using an authorized industry waste company.

#### Precaution for Foreign Exchange and Foreign Trade act

Since our Products might fall under controlled goods prescribed by the applicable foreign exchange and foreign trade act, please consult with ROHM representative in case of export.

#### **Precaution Regarding Intellectual Property Rights**

- 1. All information and data including but not limited to application example contained in this document is for reference only. ROHM does not warrant that foregoing information or data will not infringe any intellectual property rights or any other rights of any third party regarding such information or data. ROHM shall not be in any way responsible or liable for infringement of any intellectual property rights or other damages arising from use of such information or data.:
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# **General Precaution**

- 1. Before you use our Products, you are requested to care fully read this document and fully understand its contents. ROHM shall not be in an y way responsible or liable for failure, malfunction or accident arising from the use of a ny ROHM's Products against warning, caution or note contained in this document.
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